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The writer would also value information about any nepheline rocks in Massachusetts.

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A SIMPLE ATMOMETER

FOR determining the differences between the evaporating power of the air in different localities, as in the case of studies dealing with the relation of meteorological conditions to plant growth, the atmometer here described has proved very satisfactory. This instrument utilizes a porous clay bougie for the evaporating surface, after the manner of an atmometer devised by Babinet and described in 1848.[1] It is a modification of a form independently devised by the author for physiological purposes, and described in Publication No. 50 of the Carnegie Institution, 1906.

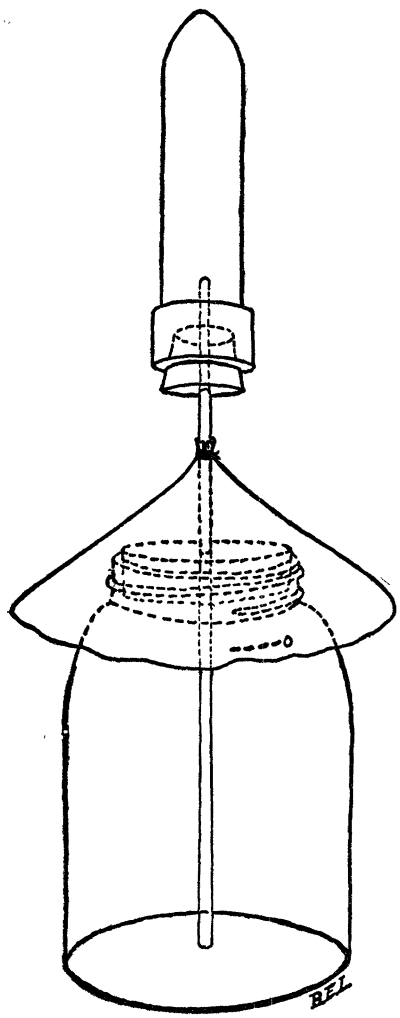

FIG. 1. Porous Cup Atmometer

The bougie is about 13 cm. long and 2.5 cm. in diameter, closed and rounded at one end and reinforced at the other by a thickened rim. The wall, of unglazed porcelain similar to that used for filter tubes, is about 4 mm. in thickness. The open end is closed by a perforated rubber stopper bearing a glass tube about 30 cm. in length, which extends through a cork stopper nearly to the bottom of a glass jar of the "Mason" pattern. Any bottle will serve as well, and a graduated flask serves better, but the "Mason" jar was adopted because of the ease with which it may be obtained almost anywhere in the United States. To allow access of air to the jar, the cork stopper should fit the latter somewhat imperfectly, or should have a slight groove cut in its margin. Above the jar the tube passes through a conical cap of cloth which is rendered water-proof by means of shellac. This serves to shed rain water and to prevent its direct entrance to the jar. An external file-mark on the jar, near the shoulder (*O* in the figure), serves as a fixed water-level. A pint, quart or half-gallon jar is used, according to the evaporation rate and the time period during which the instrument is to operate without refilling.

In setting up this instrument, the jar is partially filled with distilled water, the bougie (which has been soaked in distilled water to remove air) is filled and its stopper inserted with the glass tube, the tube is filled, and its free end quickly thrust to the bottom of the jar. In the last operation air must not enter the tube. The jar is next filled to the file-mark, the cork stopper placed in position, and the instrument is ready for operation. When the apparatus is thus arranged, the water films closing the pores at the outer surface of the bougie possess a tensile strength adequate

[1] Babinet, J., *Compt. Rend.*, **27**: 529–30, 1848.

to prevent penetration of air through the walls, and the bougie remains filled with water, although it is above the water-level in the jar. Evaporation proceeds from the surface of the bougie, water being drawn into the pores to replace what has been lost. The water thus removed from the cavity of the bougie is in turn replaced from the reservoir, and evaporation may continue as long as the tube reaches the water in the latter.

After the lapse of a time period the cork stopper is loosened, slightly raised, and slipped sidewise as far as the tube will permit, its lower surface resting on the edge of the jar. The latter is then refilled to the standard level from a graduated vessel, and the amount of water required to refill is the amount which has been evaporated during the preceding period.

Only pure water is to be used in this instrument, for otherwise a rapid clogging of the pores of the bougie ensues. Water from an ordinary still is satisfactory. To prevent the growth of microorganisms in and on the bougie, which might clog the pores, formaldehyde may be added to the water, to make a 3–5 per cent. solution. This does not interfere appreciably with the operation of the instrument. The bougies, as received from the factory, are, of course, not strictly uniform in porosity, and it is necessary to standardize them by comparing their evaporation rates, under uniform conditions, with that from a standard bougie. The latter is not used excepting for standardizing, and is kept protected from dust and moisture when not in use. A coefficient of correction is obtained by standardizing, which is applied to the readings obtained in actual operation. If properly used the bougies will operate for at least four months without appreciable alteration in their coefficients of correction. It is well, however, to restandardize them at the end of a season's work.

When exposed in the open, rain may fall upon the surface of the bougie, and as long as this surface is wet the water movement in the instrument is reversed, and water actually enters the jar, at a rate determined by the porosity of the bougie and by the height of the water-level in the jar at the time. This error, is, however, very small excepting for long periods of rainy weather. A correction coefficient may be obtained and applied, but the application must depend upon a record of the duration of precipitation periods. Of course the error here mentioned might be avoided by placing a small screen above the instrument, but such a screen would alter the evaporation rate to some extent, even though it were made of glass, and, since the influx of heat from the sun in different localities varies to a marked degree, a screen is not desirable.

This atmometer may be read daily, weekly or monthly, in fact at any convenient intervals, the only condition being that the water-supply in the reservoir must be adequate for the chosen period. The tube may be lengthened to several times the given length without affecting the accuracy of the readings, so that a large reservoir may be used for very long periods. The rate of water loss from the bougie may be reduced by partially coating the surface of the latter with shellac, or a smaller bougie may be used.

This form of instrument has few of the objectionable features possessed by the common open vessel atmometer. It does not attract birds and other small animals and is not subject to errors on account of their visits. It is especially adapted to studies of the effect of wind on evaporation, for high winds do not produce any error, as they so often do in open vessels, by the blowing of liquid water from the surface and by producing variation in the effectual surface itself. It may be standardized so as to give results in terms of depth of evaporation, as usually given, by comparing it with whatever form of open vessel the observer may choose as standard for this purpose. It is self-recording and self-integrating, as far as data for a mean rate are concerned, and, finally, is so inexpensive that several instruments may be exposed at a single locality, thus decreasing the chance of error.

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